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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1 53(b))

Attorney Docket No.	BWD:7156.053
First Inventor or Application Identifier	HUANG, Austin L.
Title	PROJECTION DISPLAY HAVING POLARIZA...
Express Mail Label No.	EL399607534US

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)*
(Submit an original and a duplicate for fee processing)

2. [X] Specification [Total Pages 18]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 4]

4. Oath or Declaration [Total Pages 2]

a. [X] Newly executed (original or copy)

b. [ ] Copy from a prior application (37 C.F.R § 1.63(d))
(for continuation/divisional with Box 16 completed)

i. [ ] DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

* NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*

6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. [ ] Computer Readable Copy
b. [ ] Paper Copy (identical to computer copy)
c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [X] Assignment Papers (cover sheet & document(s))

8. [X] 37 C.F.R.§3.73(b) Statement [ ] Power of
(when there is an assignee) [X] Attorney

9. [ ] English Translation Document *(if applicable)*

10. [X] Information Disclosure Statement (IDS)/PTO-1449 [7] Copies of IDS Citations

11. [ ] Preliminary Amendment

12. [X] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)

13. [ ] * Small Entity Statement(s) (PTO/SB/09-12) [ ] Statement filed in prior application, Status still proper and desired

14. [ ] Certified Copy of Priority Document(s)
(if foreign priority is claimed)

15. [X] Other: Check for $1,034.00 No. 51555

16. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: _____/_____

Prior application information: Examiner _____ Group / Art Unit: _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation <u>can only</u> be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

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Signature		Date	11/15/99

CERTIFICATE OF MAILING

BY "EXPRESS MAIL"

Express Mail No. EL399607534US

Date of Deposit: November 15, 1999

   I hereby certify that the utility patent application
attached hereto entitled PROJECTION DISPLAY HAVING POLARIZATION
COMPENSATOR totaling 18 pages, together with four (4) sheets of
formal drawings, a Declaration and Power of Attorney signed by
Austin L. Huang, an assignment, an assignment recordation form
cover sheet, certificate under 37 CFR §3.73(b), a utility patent
application transmittal form, a fee transmittal form (in
duplicate), IDS with form 1449, a check for $1,034.00, this
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DWIGHT BERGQUIST-MOODY

PROJECTION DISPLAY HAVING POLARIZATION COMPENSATOR

BACKGROUND OF THE INVENTION

The present invention relates to a polarization

5   compensator used to compensate for the depolarization
effects due to geometric, thermal, and material
birefringence in an optical system. An optical system
that utilizes polarization as the means for contrast
control will benefit from this method of

10   compensation.

It is well known that the polarization of light
within an optical system is greatly influenced by the
incident angle the light makes with respect to the
different surfaces in the optical system. This results

15   from the different Fresnel reflection coefficients for
each polarization state. Polarization defects may be
manifested as the "Maltese Cross" or thermal
birefringence.

For example, in one optical system such as a

20   liquid crystal light valve projector, an illumination
source shines light onto a polarizer that reflects s
polarized light to a liquid crystal display (LCD) panel,
also referred to as a liquid crystal light valve (LCLV).
If the LCD is fully activated, then the LCD converts the

25   s polarized light to p polarized light after it is
reflected by a dielectric mirror behind the LCD. The p
polarized light is reflected back to the polarizer, where
it passes through the polarizer to the projection screen.
If the LCD segment is not activated, then it does not

30   change the polarization of the light and the light
remains s polarized. The s polarized light is reflected
back to the polarizing surface which in turn reflects the
light back towards the illumination source. In a perfect
system, 100% of the light reflected from the polarizer to

35   the LCD is s polarized light. However, the polarizer
does not reflect 100% s polarized light because of
geometrically induced errors in the polarizer. Due to

the cone of light that is incident on the LCD, all of the light in the cone is not polarized in the s direction by the polarizer with respect to the LCD. There are small rotations in polarization direction due to the angle of

5 incidence of the light directed onto the polarizing surface. In this situation a higher degree of twist in the polarization axis occurs for a ray with a higher angle of incidence. The direction of rotation of the polarization away from the ideal is dependent upon the

10 angle of incidence of the ray. For example, a ray incident at 5° might rotate the polarization axis by 2° while a ray incident at -5° would rotate the polarization axis by -2°.

The light rays with polarizations that have

15 been slightly rotated away from the ideal are reflected by the dielectric mirror in the LCD and return to the polarizer with their polarization axis still slightly rotated. This causes a slight percentage of these rays to plunge into the polarizer instead of being reflected

20 by the polarizer. This small percentage of light is then projected onto the projection screen. Thus, when the LCD is completely off or inactivated, a small percentage of the light reflected off the LCD will not be completely polarized in the s direction with respect to the

25 polarizing surface. This causes unwanted light to pass through the polarizer and slightly illuminate the screen, causing the "dark" state to be slightly illuminated which reduces the contrast ratio of the projection system.

Another problem associated with a dark or off

30 state of the LCD projector is the problem of birefringence introduced by thermal gradients across the counter electrode substrate. The LCD itself, including the substrate, is packaged in an anodized aluminum case to reduce reflections that cause unwanted light

35 scattering. Thus, light striking the case holding the LCD is absorbed, creating heat in the LCD package. This heat is transferred to the counter electrode substrate

which causes the temperature to rise in the substrate, creating a thermal gradient across the substrate. This thermal gradient creates birefringence, causing the dark state or off state of the LCD to be "lighter" than

5   desired. Therefore, when the LCD is completely turned off, what should be a totally black screen will actually have some light projected on the screen, causing the screen to appear gray instead of a deep black. Therefore, it would be desirable to eliminate the

10 birefringence caused by the thermal gradients across the counter electrode substrate and thereby improve the contrast ratio by making the dark or off state of the LCD appear black instead of gray on the projection screen.

    The primary conventional approach to

15 polarization compensation is to use a birefringent film, typically quarter wave retardation films for reflective LCD panels and half wave retardation films for transmissive LCD panels. Examples of such systems include U.S. Patent No. 5,459,593 and U.S. Patent No.

20 5,576,854. However, this is only a partial solution to the problem, because this approach does not fully compensate for all of the different off-axis rays, and slightly different polarization states and orientation that is caused by the optical components in the system.

25 In addition, because this system is passive, i.e. the retardance value of the film is fixed, the retardance cannot be changed to correct for current operating conditions, or to optimize performance of the system.

    What is therefore desired is a projection

30 display having a polarization compensator that is capable of providing improved polarization correction, that improves the contrast of the projection display system without sacrificing brightness, that corrects local polarization defects, and that allows an active

35 correction of polarization defects to optimize correction of polarization defects based on current operating conditions.

BRIEF SUMMARY OF THE INVENTION

The present invention overcomes the drawbacks of the prior art by providing a projection display system having a polarization compensator. The projection display system includes a light source, at least one polarizer, at least one liquid crystal panel, and a projection lens for projecting an image. The polarization compensator has a plurality of regions each having a respective birefringence. The birefringence of one of the regions is different than the birefringence of another of the regions.

The present invention also provides a method for displaying an image. The method comprises the steps of providing polarized light, generating an image from the polarized light, correcting a plurality of polarization defects of the light by correcting at one location one polarization defect and correcting at another location another polarization defect, and projecting the image.

The various aspects of the present invention have one or more of the following advantages. The polarization compensator is capable of correcting polarization defects on a local basis, in contrast to the prior art systems which allow only a single, uniform correction provided by a single, passive retardation film. By correcting polarization defects locally, the system achieves greater contrast without sacrificing brightness. The present invention also provides embodiments which allow the polarization defects to be corrected locally through the use of electronically controllable birefringence. This provides for greater control over the correction of polarization defects. It also allows the birefringence to be changed locally over time, so that the polarization defects can be changed as needed at different times. This also enables the use of a feedback mechanism to automatically adjust the

polarization compensator to yield the best system
contrast under all operational condition.

5   The foregoing and other objectives, features,
and advantages of the invention will be more readily
understood upon consideration of the following detailed
description of the invention, taken in conjunction with
the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

10   FIG. 1 is a schematic diagram of an exemplary
embodiment of a projection display of the present
invention.

FIG. 2 is a front view of an exemplary
embodiment of a polarization compensator.

15   FIG. 3 is a front view of another exemplary
embodiment of a polarization compensator.

FIG. 4 is a side view of a light beam traveling
left to right through an exemplary polarization
compensator.

20   FIG. 5 is a cross section of the light beam of
FIG. 4 taken along the line 5-5.

FIG. 6 is a cross section of the light beam of
FIG. 4 taken along the line 6-6.

FIG. 7 is a side view of a ray diagram of an
25   exemplary projection display system.

FIG. 8 is a schematic view of a conventional
optical axis orientation of a liquid crystal device.

FIG. 9 is a schematic view of an optical axis
orientation of an exemplary polarization compensator of
30   the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the figures, wherein like
numerals refer to like elements, FIG. 1 shows an
35   exemplary projection display 10 having a light source 12
and three reflective liquid crystal display (LCD) panels
14, 16, and 18, also referred to as liquid crystal light

valves. The light from light source 12 passes through a
polarizing device 13, such as a polarization converter,
so that the light entering the entrance pupil 70 is
polarized. Dichroic filter 20 splits the light into two
5   color components. For the sake of illustration only,
dichroic filter 20 transmits red light while reflecting
blue and green light. Referring to the path of the red
light component, the red light then passes through
polarizer 22 and enters polarizing beam splitter 24. One
10   polarization component (e.g., the s polarized component)
is reflected by the beam splitter 24 toward the LCD panel
14, which generates a red image. The reflected image
(now in the p polarization state) passes through the beam
splitter 24 and through analyzer 26. The red light is
15   then reflected by dichroic filter 28, and then
transmitted through projection lens 30.

Turning to the blue and green color components,
these are reflected by dichroic filter 20 and pass
through polarizer 32 that transmits only s polarized
20   light. The light then passes through a selective color
component rotator 34, that rotates one of the light
components (e.g., blue) from one polarization state
(e.g., the s polarization state) to another polarization
state (e.g., the s polarization state). (Color component
25   rotator 34 is a wavelength specific half-wave plate, and
may be obtained from Color Link in Boulder Colorado or
Cambridge Research and Instrumentation in Cambridge,
Massachusetts.) Thus, the two color components (green
and blue) entering the polarizing beam splitter 36 have
30   different polarization states (e.g. s and p,
respectively). The polarizing beam splitter reflects one
of the color components (green) and transmits the other
(blue). The light reflecting off of and passing through
the polarizing beam splitter 36 is imaged using LCD
35   panels 16 and 18. The green component image reflected by
LCD panel 16 is transmitted through polarizing beam
splitter 36 while the blue component image reflected by

LCD panel 18 is reflected by the polarizing beam splitter 36. Both the blue and green components pass through another selective color component rotator 38, so that the two color components again have the same polarization

5 state. The blue and green color components then pass through an analyzer 40. The blue and green color components then pass through dichroic filter 28, where they are combined with the red color component and projected through projection lens 30.

10 While an exemplary projection display 10 has been described, other projection display configurations that utilize LCD panels (reflective or transmissive) and polarizing devices may find utility with the present invention. Moreover, other color components, wavelength

15 ranges, and polarization states may be used as desired.

The key to the present invention is the inclusion in the projection display system 10 of one or more polarization compensators 50. FIG. 2 shows a preferred embodiment of polarization compensator 50

20 having regions, preferably pixels 52, arranged in concentric fashion. Each pixel 52 has a respective birefringence. As polarized light passes through the various regions or pixels 52, the polarization of the light may be changed or adjusted depending on the

25 birefringence of the particular pixel (or group of pixels). As described above, polarization defects may accumulate in the polarized light as the light passes through the projection display system. The polarization compensator 50 corrects these polarization defects on a

30 local basis (pixel-to-pixel), thus having the ability to compensate more fully the different polarized light components that are incident to the polarization compensator. Thus, the polarization compensator 50 corrects the polarization defects within the light on a

35 localized basis. The polarization compensator also may be used to linearalize an elliptically polarized input; that is, correct defects that create elliptically

polarized light so that the light is either fully s or p
polarized.

FIGS. 4-6 illustrate this localized correction
of polarization defects. FIG. 4 illustrates a polarized
5   light beam 60 traveling from left to right through a
polarization compensator 50. FIG. 5 is a cross section
of the polarized light beam prior to correction of the
polarization defects. The arrows 62 represent the
polarization direction, whether p (straight up and down)
10   or s (side to side). As can be seen, the light 62 at the
center of the light beam is substantially in the p
polarization state, but the light has polarization
defects, in that the light beam 60 contains significant
amounts of s polarization as one travels from the center
15   to the lateral edges of the light beam, such as at 64.
In addition, it is also seen that the polarization
defects are not uniform, and thus would not be completely
corrected using a traditional halfwave plate.

FIG. 6 illustrates a cross section of the light
20   beam 60 after passing through the polarization
compensator 50. As can be seen, the polarization
compensator did not change the polarization of the light
62' at the center of the beam, but corrected those other
portions containing s components, such as at 64'. As a
25   result, the polarized light beam is substantially p
polarized, without an appreciable loss of brightness.

Referring again to FIG. 1, polarization
compensator(s) 50 may be placed at any location in the
projection display system 10 following polarization of
30   the light. Suggested placement of the polarization
compensator(s) 50 would be at the entrance pupil 70 or
exit pupil 72 (illumination and projection aperture stop
respectively). Another possible location to place the
polarization compensator 50 would be directly in front of
35   the LCD imager panels 14, 16 and 18. Alternatively, the
polarization compensator 50 could be built into the LCD
imager panels 14, 16 and 18 themselves. Another possible

location is between the polarizer/analyzer pairs, such as after the polarizer 22 or before the analyzer 26. FIG. 1 illustrates a variety of possible locations for polarization compensator(s) 50. Of course, the present

5   invention may be used with only a single polarization compensator 50, the number shown in FIG. 1 being for purposes of showing possible locations only.

A preferred location for the polarization compensator is the aperture stop. Referring now to FIG.

10   7, there is one unique physical location in the optical system where the angular distribution of the light is directly related to its physical location. This place is known as the aperture stop, and is shown at 80 in FIG. 7. (For ease of illustration, FIG. 7 depicts a simplified

15   projection display system utilizing a transmissive LCD imager panel 82, lenses 84, polarizer 86 and analyzer 88.) Assuming a circularly symmetric optical system (as most systems are) the radial distance from the "center" of the aperture stop represents an increase in the angle

20   of light that strikes the image or object planes. This is where the polarization compensator should be placed for the maximum polarization correction effect. Of course, the number and placement of polarization compensator(s) 50 will be determined by the projection

25   display system architecture.

Polarization compensators 50 may take any form in which the polarization compensator is capable of correcting polarization defects on a local or pixel-to-pixel basis. One preferred embodiment of a polarization

30   compensator is one in which the polarization compensator 50 is a transmissive liquid crystal device having electrically controlled birefringence. The pixels of the transmissive LCD would ideally have a concentric circular pattern (like a bulls-eye target), as shown in FIG. 2.

35   Alternatively, a standard rectangular matrix pattern (or any other organization) for the pixels could be used, as shown in FIG. 3. The polarization compensator may have a

nominal retardance value of 278 nm (half wave for green
light in single pass) and it could be compensated with
film retardance in order to get a broadband optical
response. The pixels can be individually controlled to

5   have retardance values anywhere from 0 to 278 nm thereby
enabling the polarization compensator to compensate for
incident polarization states that are elliptical through
90 degrees out of phase. Thus, the system may correct an
elliptically polarized input that should instead be

10   linearly polarized.

In addition, a second parameter, the director
orientation of the transmissive LCD panel of the
polarization compensator, may be varied if a
photolithography method is used in the cell construction

15   of the polarization compensator. The director
orientation controls the twist of the liquid crystals,
and hence the degree of change in polarization of light
passing through the LCD panel. Conventional mechanical
rubbing processes used to make LCD panels produce uniform

20   director orientations, as illustrated in the LCD panel
50' FIG. 8. However, the alignment layer of an LCD panel
may be patterned using photolithography, which allows the
director orientations of the individual pixels to be
varied on a pixel-by-pixel basis. FIG. 9 represents one

25   such possible polarization compensator 50 in which the
pixels 52 have varying director orientations 54. The
combination of electronically controllable
retardance/birefringence and patternable director
orientation for each pixel of a matrix allows for

30   improved correction of the polarization orientation of
the light in an optical system.

The ability to electrically control the
birefringence on a local, pixel by pixel basis, allows
for several advantages. First, the polarization defects

35   may be corrected in real time "on the fly." That is, the
polarization compensator 50 may be adjusted to allow for
optimal contrast while the projection display 10 is

operating, so that the polarization compensator 50 accounts for polarization defects arising from current operating conditions. Second, the polarization compensator 50 may be used in conjunction with a feedback

5   mechanism to automatically adjust the polarization compensator 50 to achieve optimum polarization defect correction. Referring to FIG. 1, the projection display system 10 may include a detector 90, such as a CCD, that is connected to the drive electronics 95 of the

10   polarization compensator(s) 50. The detector 90 provides a signal to the polarization compensator 50 representative of the image generated by the projection display system 10. Through the use of such a feedback mechanism, the projection display system 10 may through

15   the drive electronics 95 automatically adjust the polarization compensator 50 to achieve the optimal performance of the system.

        It will be recognized that any value of retardance and pattern could have been selected and the

20   location of the polarization compensator(s) 50 will be determined by the projection display system design. It will also be recognized that the ability to adjust only the localized birefringence and not the director orientation will provide better polarization correction

25   than a single sheet of retardation film. In addition, where the polarization compensator 50 is an LCD, a variety of factors may be manipulated to alter the polarization characteristics of the transmitted light, such as the liquid crystal material itself, the cell gap

30   separation, the director orientation, the degree of pre-tilt, and the pixel size.

        A second less costly embodiment of a polarization compensator 50 utilizes a passive birefringent plate in which the birefringence/retardance

35   values and/or director orientation of the respective pixels varies as a function of location on the plate, but in which the pixels are not electrically controllable.

Such a polarization compensator 50 would be constructed
with prior knowledge of the values required to correct
for the various polarization defects as well as the
director orientation for each pixel location.

5   Cholesteric liquid crystal techniques are well suited for
these applications since they can be both locally
patterned to have different birefringent values as well
as have different director orientations for each pixel
location on the plate.

10   The terms and expressions which have been
employed in the foregoing specification are used therein
as terms of description and not of limitation, and there
is no intention, in the use of such terms and
expressions, of excluding equivalents of the features

15 shown and described or portions thereof, it being
recognized that the scope of the invention is defined and
limited only by the which follow.

CLAIMS

1. A projection display system, comprising:

(a)   a light source;

(b)   at least one polarizer;

(c)   at least one liquid crystal panel for generating an image;

(d)   a projection source for projecting said image; and

(e)   a polarization compensator having a plurality of regions each having a respective birefringence, said birefringence of at least one of said regions being different than said birefringence of another of said regions.

2. The projection display of claim 1 wherein said regions are arranged in a rectangular matrix.

3. The projection display of claim 1 wherein said regions are arranged concentrically.

4. The projection display of claim 1 having more than two regions.

5. The projection display of claim 1 wherein said polarization compensator is a transmissive liquid crystal device.

6. The projection display of claim 5 wherein at least one of said regions has a director orientation that is different than another director orientation of another of said regions.

7. The projection display of claim 1, further comprising an analyzer, and said polarization compensator is located between said polarizer and said analyzer.

8. The projection display of claim 1 wherein said polarization compensator is located at an aperture stop of said projection display.

9. The projection display of claim 1 wherein said polarization compensator is built into said liquid crystal panel.

10. The projection display of claim 1 wherein said polarization compensator is located at one of an entrance pupil and an exit pupil.

11. The projection display of claim 1 wherein said polarization compensator is located adjacent to said liquid crystal panel.

12. The projection display of claim 1 wherein each of said regions has electrically controlled birefringence.

13. The projection display of claim 12, further comprising a feedback mechanism to adjust said birefringence of said regions.

14. The projection display of claim 12 wherein said birefringence of said regions is adjustable over time.

15. The projection display of claim 1 wherein said birefringence of each of said regions is fixed.

16. The projection display of claim 1, further comprising a plurality of liquid crystal panels.

17.   A method for displaying an image, comprising:

    (a)   providing polarized light;

    (b)   generating an image from said polarized light;

    (c)   correcting a plurality of polarization defects of said light by correcting at one location one polarization defect and correcting at another location another polarization defect where said correcting at said one location is different than said correcting at said another location, each of said locations being located in a plane that is substantially perpendicular to said light; and

    (c)   projecting said image.

18.   The method of claim 17 wherein said locations correspond to pixels.

19.   The method of claim 18 wherein said pixels are arranged in a rectangular matrix.

20.   The method of claim 18 wherein said pixels are arranged concentrically.

21.   The method of claim 17 wherein said polarization defects are corrected at more than two locations.

22.   The method of claim 17 wherein said polarization defects are corrected using a transmissive liquid crystal device.

23. The method of claim 22 wherein said transmissive liquid crystal device has at least one pixel having a director orientation that is different than another director orientation of another pixel.

5

24. The method of claim 17, further comprising transmitting said light through an analyzer, and said polarization defects are corrected before said light is transmitted through said analyzer.

10

25. The method of claim 17 wherein said polarization defects are corrected at an aperture stop.

26. The method of claim 17 wherein said
15 polarization defects are corrected at a liquid crystal panel.

27. The method of claim 17 wherein said polarization defects are corrected at one of an entrance
20 pupil and an exit pupil.

28. The method of claim 17 wherein said polarization defects are corrected at a location adjacent to a liquid crystal panel.

25

29. The method of claim 17 wherein said polarization defects are corrected by providing a polarization compensator having a plurality of pixels each having a respective birefringence, said
30 birefringence of one of said pixels being is different than said birefringence of another of said pixels.

30. The method of claim 29, further comprising electronically controlling said birefringence of said
35 pixels.

31. The method of claim 17 further comprising the step of feeding back an output signal representative of said light in order to correct said polarization defects.

32. The method of claim 17 wherein said polarization defects are corrected at different times.

33. The method of claim 27 wherein said birefringence of each of said pixels is fixed.

PROJECTION DISPLAY HAVING POLARIZATION COMPENSATOR
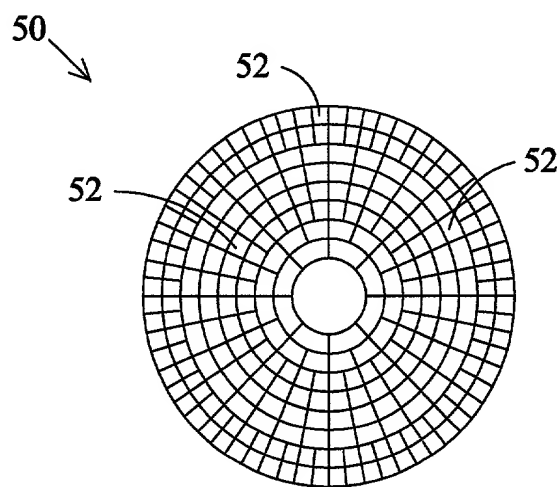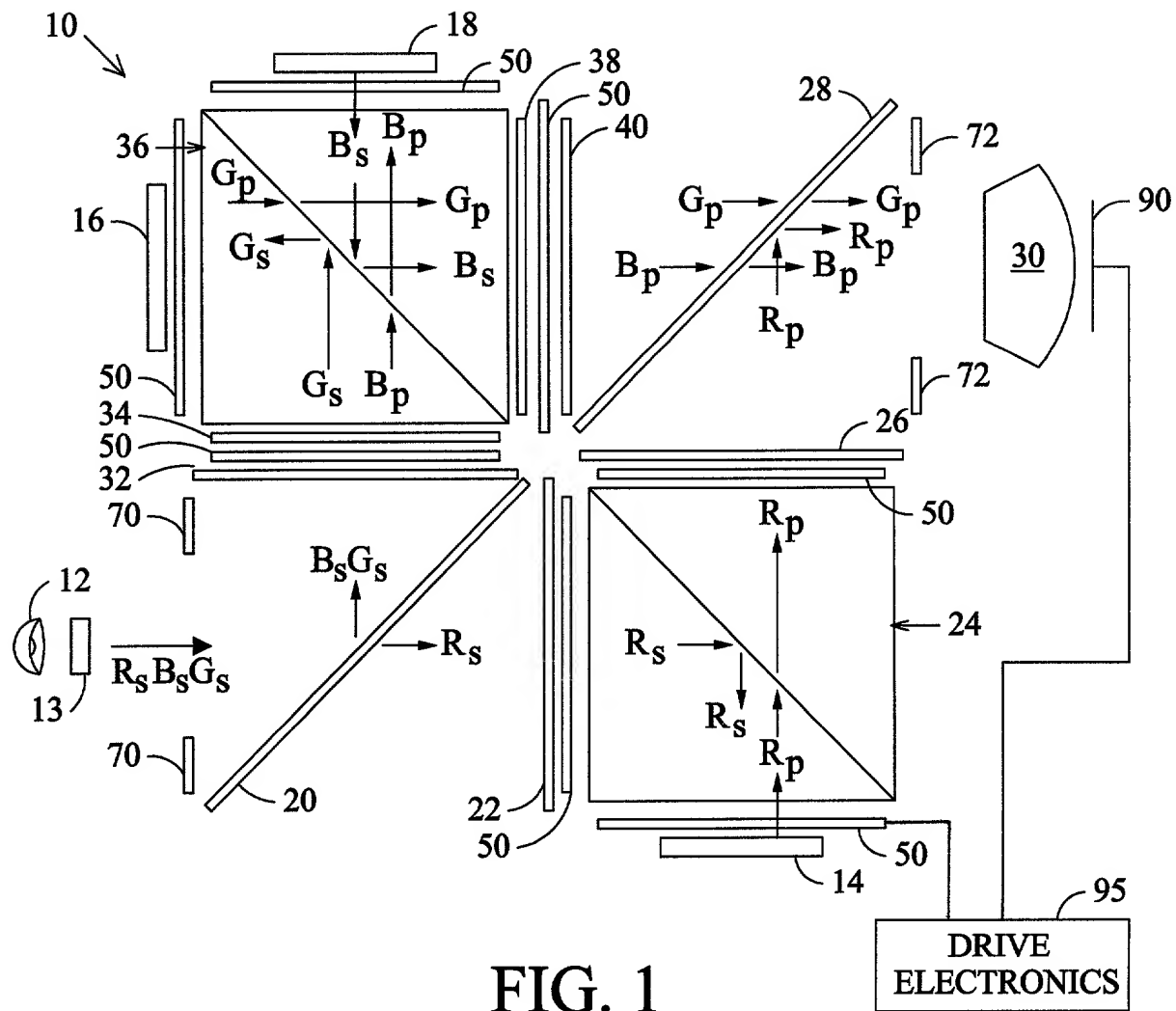
ABSTRACT OF THE DISCLOSURE

A projection display system includes a light

5   source, at least one polarizer, at least one liquid crystal panel for generating an image, and a projection lens for projecting the image. The system includes a polarization compensator having a plurality of regions each having a respective birefringence. The

10   birefringence of one of the regions is different than the birefringence of another of the regions. The birefringence of the various regions may be controlled electrically.
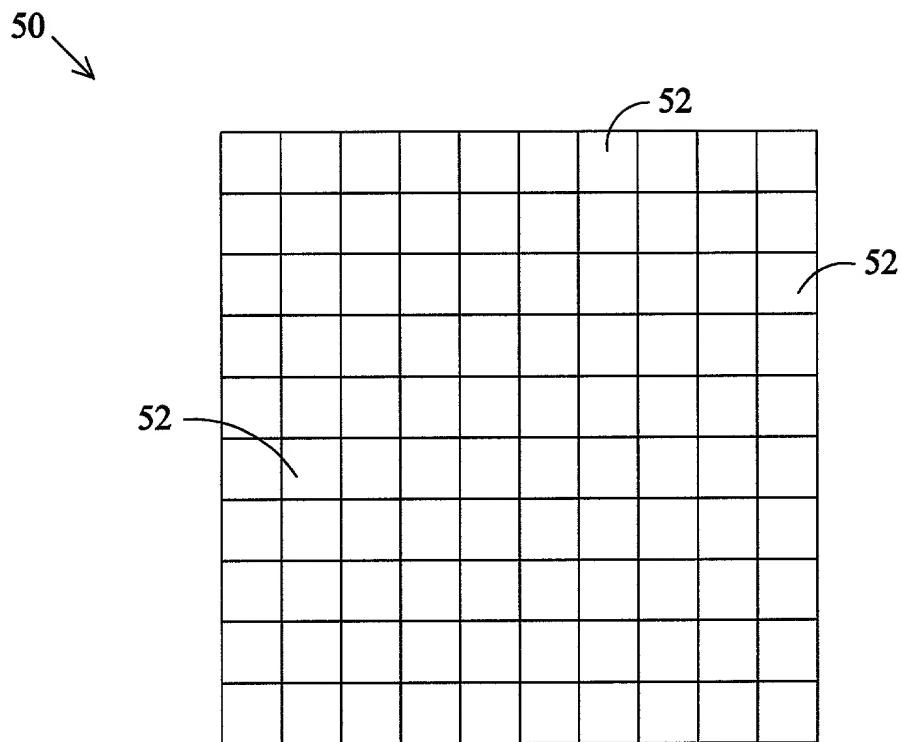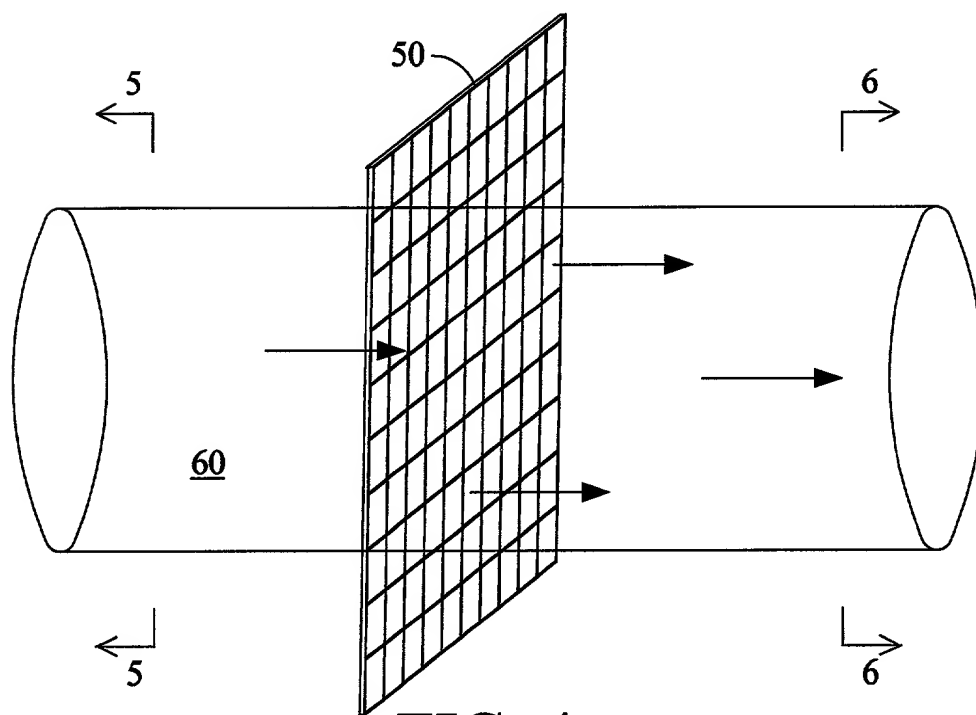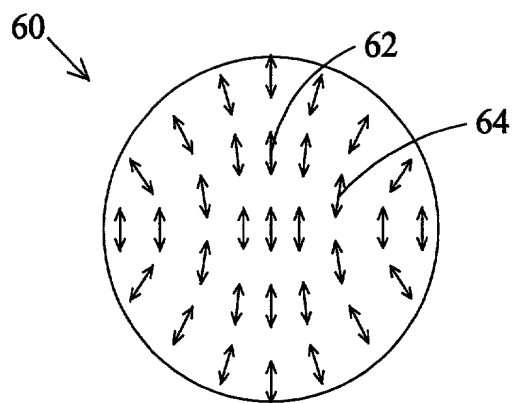
15

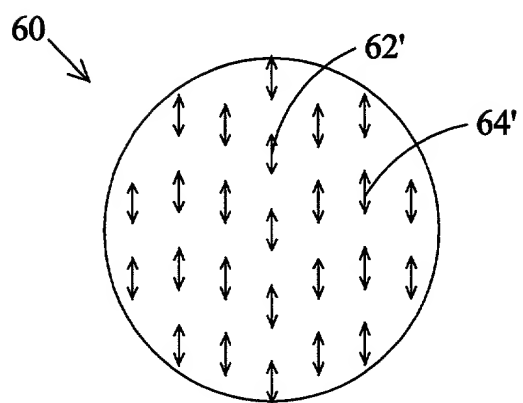20

25

30

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6
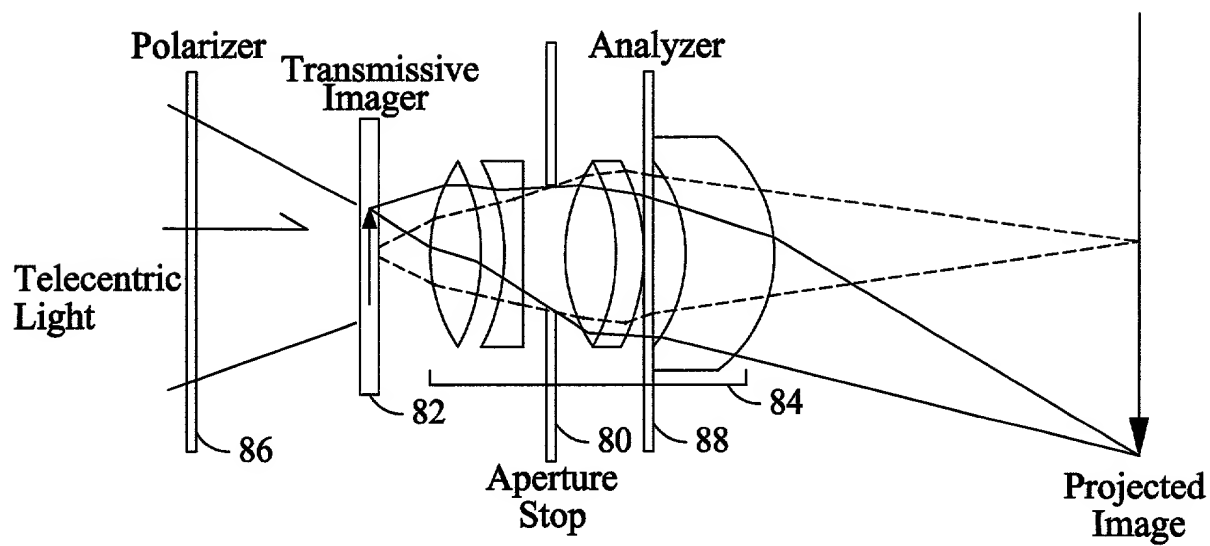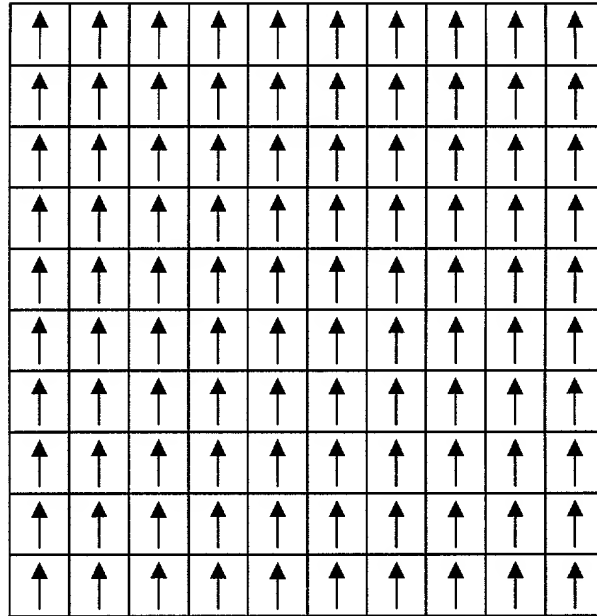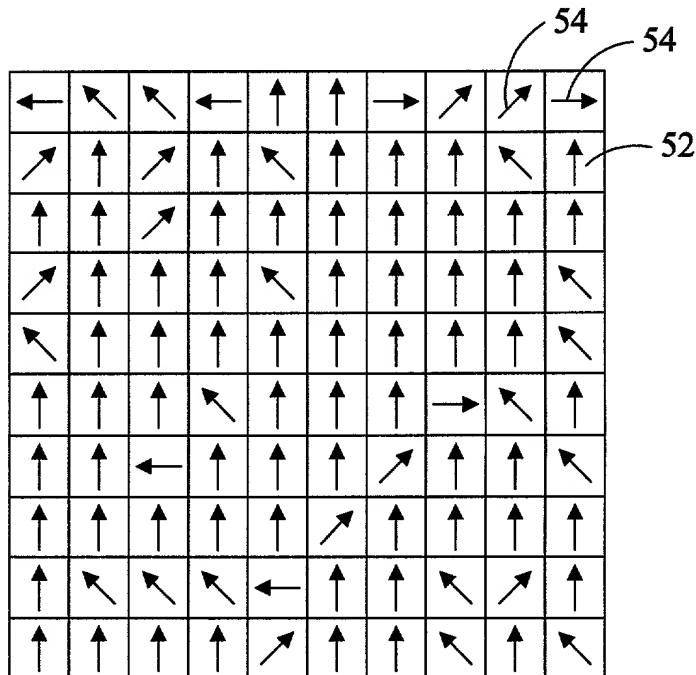

FIG. 7

FIG. 8

FIG. 9

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PROJECTION DISPLAY HAVING POLARIZATION COMPENSATOR

the specification of which

    [x]   is attached hereto.

            was filed on _____ as
    [ ]   Application Serial No. _____
            and was amended on _____.
                           (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

                                         Priority
                                         Claimed

_____ _____ _____ [ ] Yes [ ] No
  (Number)   (Country)   (Day/Month/Year Filed)

_____ _____ _____ [ ] Yes [ ] No
  (Number)   (Country)   (Day/Month/Year Filed)

_____ _____ _____ [ ] Yes [ ] No
  (Number)   (Country)   (Day/Month/Year Filed)

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

_____ _____
(Application Serial No.)   (Filing Date)

_____ _____
(Application Serial No.)   (Filing Date)

I hereby claim the benefit under Title 35, United States Code, §120, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Ser. No.)	(Filing Date)	(Status) (patented, pending, abandoned)

(Application Ser. No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby appoint Jacob E. Vilhauer, Jr., Reg. No. 24,885, Charles D. McClung, Reg. No. 26,568, Dennis E. Stenzel, Reg. No. 28,763, Donald B. Haslett, Reg. No. 28,855, William O. Geny, Reg. No. 27,444, J. Peter Staples, Reg. No. 30,690, Nancy J. Moriarty, Reg. No. 40,733, Kevin L. Russell, Reg. No. 38,292, Bruce W. DeKock, Reg. No. 40,585, Timothy E. Siegel, Reg. No. 37,442, and Timothy A. Long, Reg. No. 28,876, all of the firm of CHERNOFF, VILHAUER, McCLUNG & STENZEL, L.L.P., 600 Benj. Franklin Plaza, 1600 ODS Tower, 601 S.W. Second Avenue, Portland, Oregon 97204-3157, telephone No. (503) 227-5631, my attorneys, jointly and individually, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: _4 Nov. 1999_

Full name of sole/first inventor   Austin L. Huang

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